CLAIMS

1) A control method for controlling the fuel quantity injected into an internal combustion engine (1) comprising a number of injectors (4), each for injecting a given fuel quantity into a respective cylinder (5); for each injection inside a cylinder (5) of said engine (1), said method comprising the step of:

- determining (14) a nominal energization time (E_N) of the injector involved in said injection, as a function of injection pressure (P_{RAIL}) and the required nominal fuel quantity (Q_i);

said method being characterized by also comprising the steps of:

- determining (15) a correction energization time (E_T) as a function of injection pressure (P_{RAIL}) and the cylinder (5) involved in the injection;

- determining (16), in the event the required nominal fuel quantity (Q_i) is below a predetermined threshold (S_Q), a corrected energization time (E_C) by correcting said nominal energization time (E_N) as a function of said correction energization time (E_T); and

- exciting said injector for a time equal to said corrected energization time (E_C);

said step of determining said correction energization time (E_T) comprising the steps of:

- performing, in the presence of a predetermined series of operating conditions of said engine (1), a

succession of energizations of said injector (4) of gradually increasing energization times (E_T);

- determining a quantity (Acc) related to the output torque of said engine (1) in response to said succession of energizations; and

- calculating said correction energization time (E_T) as a function of said quantity (Acc) related to the output torque.

2) A control method as claimed in Claim 1, characterized in that said step of calculating the correction energization time (E_T) comprises the step of determining an actual energization time (E_T) of said injector, when said quantity (Acc) related to the output torque of said engine in response to said succession of energizations satisfies a predetermined relationship with a threshold (Sa) corresponding to a reference fuel quantity (Q_R).

3) A control method as claimed in Claim 2, characterized in that said predetermined relationship is defined by the condition that said quantity (Acc) related to the output torque of said engine in response to said succession of energizations be equal to said threshold (Sa).

4) A control method as claimed in Claim 2, characterized in that said step of calculating said correction energization time (E_T) comprises the step of calculating said correction energization time (E_T) as a function of said actual energization time (E_T) and of the

nominal energization time (E_N) corresponding to the reference fuel quantity (Q_R).

5) A control method as claimed in Claim 1, characterized by comprising the step of generating a correction map (15) storing a number of correction energization times (E_T), each relative to a respective operating state of the injection system defined by injection pressure (P_{RAIL}) and by the cylinder (C) to be injected.

6) A control method as claimed in Claim 5, characterized in that said step of determining said correction energization time (E_T) comprises the step of updating each said correction energization time (E_T) in said correction map as a function of said actual energization time (E_T).

7) A control method as claimed in Claim 2, characterized in that said step of performing a succession of energizations of said injector (4) of gradually increasing energization times (E_T) comprises the steps of:

- determining (120) an initial energization time (E_{Tmin}) of the injector (4) involved in said succession of energizations;

- determining (130) an incremental energization time (dE) indicating an increment to be added, at each engine cycle, to the initial energization time (E_{Tmin}) to generate said succession of energizations; and

- determining said threshold (Sa) as a function of

the reference fuel quantity (Q_R).

8) A control method as claimed in Claim 1, characterized in that said step of determining a quantity (Acc) related to the output torque of said engine (1) in response to said succession of energizations comprises the step of determining (150) the acceleration (Acc) of said engine (1).

9) A control method as claimed in Claim 8, characterized in that said step of determining an actual energization time (E_T) of said injector (4) comprises the step of determining the actual energization time (E_T) when said acceleration (Acc) of said engine (1) satisfies a predetermined relationship with said threshold (Sa).

10) A control method as claimed in Claim 8, characterized in that said step of determining the acceleration (Acc) of said engine (1) comprises the step of processing the travel times of at least two angular windows (α, ß) of a pulse wheel (11) fitted to the shaft (10) of said engine (1), each angular window having predetermined angular width and position.

11) A control method as claimed in Claim 10, characterized in that said step of determining the acceleration (Acc) of said engine (1) comprises the step of determining a correction coefficient Kc of the angular interval of one of the two angular windows (α, ß) according to the following equation:

$$Kc = \frac{\beta}{\alpha} = \frac{1}{2}\left(\frac{t(2i+1)}{t(2i)} + \frac{t(2i+1)}{t(2i+2)}\right)$$

where t(2i) and t(2i+2) are the travel times of one of the two angular windows (α) of said pulse wheel (11) in a cycle 2i and 2i+2 respectively; and t(2i+1) is the travel time of the other angular window (ß) of said pulse wheel (11) in a cycle 2i+1.

12) A control device (3) for controlling the fuel quantity injected into an internal combustion engine comprising a number of injectors (4), each for injecting a given fuel quantity into a respective cylinder (5); said control device (3) being characterized by comprising:

- energization means (14) for determining a nominal energization time (E_N) of said injector (4) as a function of injection pressure (P_{RAIL}) and the nominal fuel quantity (Q_i) required by the user;

- correcting means (15, 19) for determining a correction energization time (E_T) as a function of injection pressure (P_{RAIL}) and the cylinder (5) involved in said injection;

- control means (16) for determining, in the event the required nominal fuel quantity (Q_i) is below a predetermined threshold (S_Q), a corrected energization time (E_C) by correcting said nominal energization time (E_N) as a function of said correction energization time (E_T); and

- drive means (16) for exciting said injector (4) for a time equal to said corrected energization time (E_C);

said correcting means (15, 19) comprising:

- control means (140) for performing, in the presence of a predetermined series of operating conditions (100) of said engine (1), a succession of energizations of an injector (4) with gradually increasing energization times (E_T);

- detecting means (150) for determining a quantity (Acc) related to the output torque of said engine (1) in response to said succession of energizations; and

- processing means (170, 180) for calculating said correction energization time (E_T) as a function of said quantity (Acc) related to the output torque.

13) A control device as claimed in Claim 12, characterized in that said processing means (170, 180) comprise first calculating means (170) for determining an actual energization time (E_T) of said injector (4) when said quantity (Acc) related to the output torque satisfies a predetermined relationship with a threshold (Sa) corresponding to a reference fuel quantity (Q_R).

14) A control device as claimed in Claim 13, characterized in that said predetermined relationship is defined by the condition that said quantity (Acc) related to the output torque of said engine in response to said succession of energizations be equal to said threshold (Sa).

15) A control device as claimed in Claim 14, characterized in that said processing means (170, 180) comprise second calculating means (180) for determining

said correction energization time (E_T) as a function of said actual energization time (E_T) and of the nominal energization time (E_N) corresponding to the reference fuel quantity (Q_R).

16) A control device as claimed in Claim 12, characterized in that said correcting means (15) comprise a correction map (15) storing a number of correction energization times (E_T), each relative to a respective operating state of the injection system (2) defined by injection pressure (P_{RAIL}) and by the cylinder (C) to be injected.

17) A control device as claimed in Claim 12, characterized in that said correcting means (19) comprise:

- third calculating means (110) for determining an initial energization time (E_{Tmin}) of the injector (4) involved in said succession of energizations; and

- fourth calculating means (130) for determining said threshold (Sa), and an incremental energization time (dE) indicating an increment to add, at each engine cycle, to said initial energization time (E_{Tmin}) to generate said succession of energizations.

18) A control device as claimed in Claim 12, characterized by comprising measuring means (18) for supplying said correcting means (19) with said quantity related to the torque of the engine (1).

19) A control device as claimed in Claim 18, characterized in that said quantity related to the torque

of the engine (1) is defined by the acceleration of said engine (1).

20) A control device as claimed in Claim 19, characterized by comprising a pulse wheel (11) fitted to the shaft (10) of said engine (1); and an electromagnetic sensor (12) associated with the pulse wheel (11) and generating a movement signal (M) related to the speed and angular position of the shaft (10); said measuring means (18) processing said movement signal (M) and said speed to supply the acceleration (Acc) of said shaft (10) of said engine (1).